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Wells

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(54) **VENTED CHECK VALVES, PUMPS AND REFILL UNITS WITH VENTED CHECK VALVES**

(71) Applicant: **GOJO Industries, Inc.**, Akron, OH (US)

(72) Inventor: **Jesse D. Wells**, Canton, OH (US)

(73) Assignee: **GOJO Industries, Inc.**, Akron, OH (US)

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(51) **Int. Cl.**

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B05B 11/00	(2006.01)
A47K 5/14	(2006.01)
B05B 7/00	(2006.01)
A47K 5/12	(2006.01)

(52) **U.S. Cl.**

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(58) **Field of Classification Search**

CPC F04B 7/0003; A47K 5/14

USPC 222/190, 321.1, 321.7–321.9, 383.1, 222/383.3, 332, 442, 481.5, 188, 387, 372; 417/443

See application file for complete search history.

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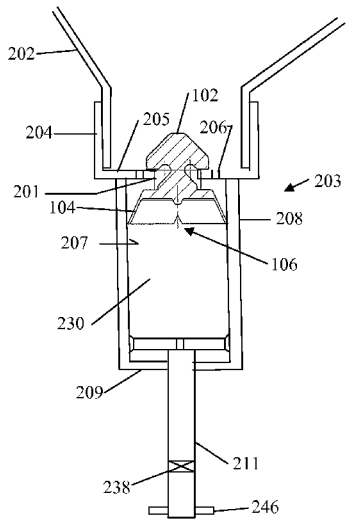
Primary Examiner — Donnell Long

(74) *Attorney, Agent, or Firm* — Calfee, Halter & Griswold LLP

(57) **ABSTRACT**

Vented check valves, pumps and refill units for dispensers are disclosed herein. Some embodiments disclose a refill unit including a container for holding a liquid. A pump chamber is secured to the container. The pump chamber is defined at least in part by a one-way liquid inlet check valve, a one-way liquid outlet check valve and at least one wall. The volume of the pump chamber is movable between a first volume and a second volume. The inlet check valve includes a venting recess. The venting recess allows air to flow past the inlet check valve in the opposite direction of the flow of liquid into the liquid chamber.

20 Claims, 2 Drawing Sheets



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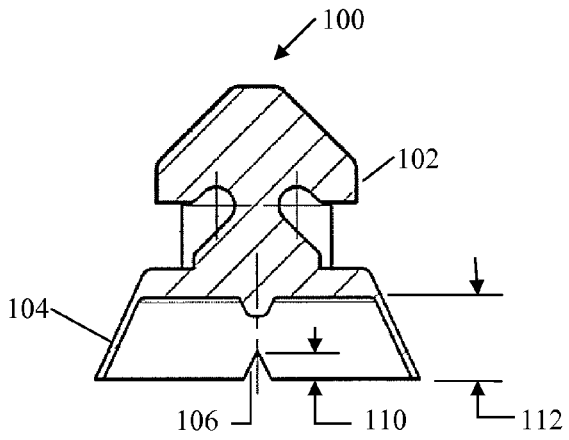

FIG 1A

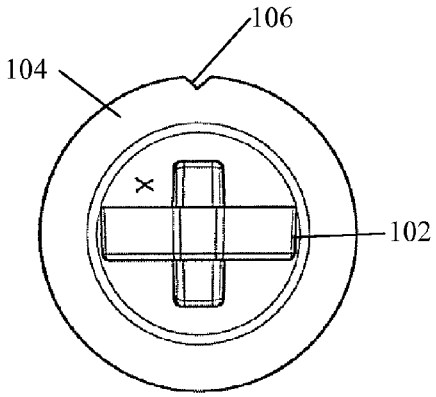

FIG 1B

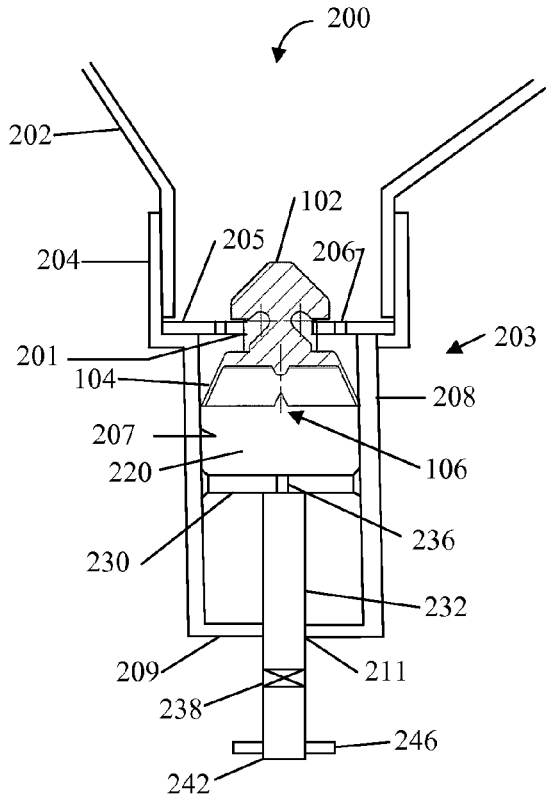

FIG 2A

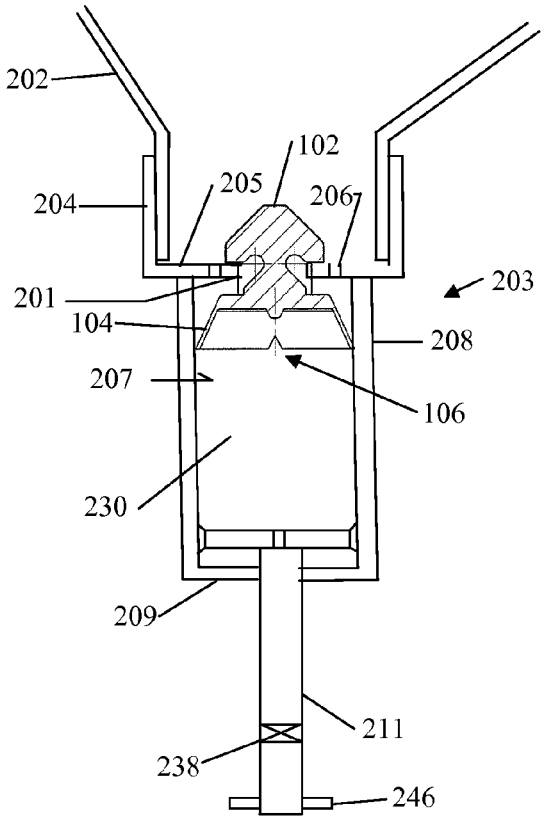

FIG 2B

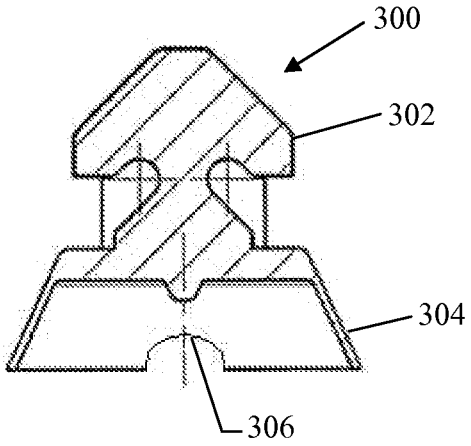

FIG 3

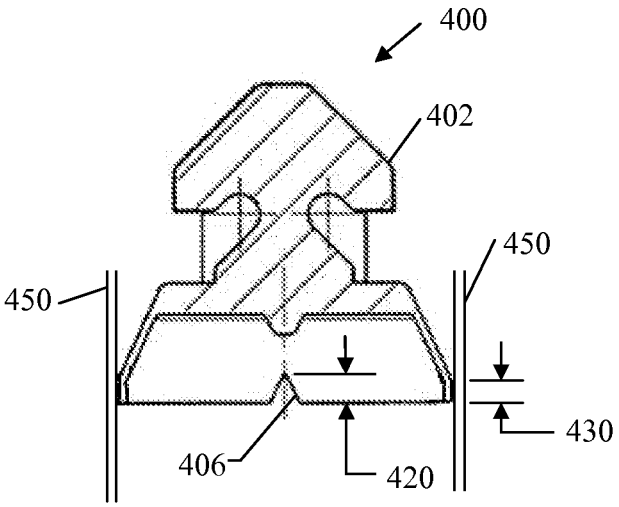

FIG 4

VENTED CHECK VALVES, PUMPS AND REFILL UNITS WITH VENTED CHECK VALVES

RELATED APPLICATIONS

This non-provisional utility patent application claims priority to and the benefits of U.S. Provisional Patent Application Ser. No. 61/735,795 filed on Dec. 11, 2012, and entitled VENTED CHECK VALVES, PUMPS AND REFILL UNITS WITH VENTED CHECK VALVES. This application is incorporated herein by reference in its entirety.

TECHNICAL FIELD

The present invention relates generally to check valves, pumps and refill units, and more particularly to vented check valves, pumps and refill units having vented check valves.

BACKGROUND OF THE INVENTION

Liquid dispenser systems, such as liquid soap and sanitizer dispensers, provide a user with a predetermined amount of liquid upon actuation of the dispenser. In addition, it is sometimes desirable to dispense the liquid in the form of foam by, for example, injecting air into the liquid to create a foamy mixture of liquid and air bubbles by use of an air pump or air compressor. Most pumps, whether liquid pumps or foam pumps have a constant volume output and to change the volume requires one to change the pump or "short-stroke" the pump. A pump is short-stroked when the actuator of the dispenser is prevented from moving its full stroke. Problems often occur with pumps when they are short-stroked. If a blocking plate is added to the dispenser actuator so that the actuator does not drive the liquid piston the full length of the pump chambers, many pumps will not prime because an air bubble remains in the liquid piston. Another problem is that air trapped in the liquid dosing chamber results in an inconsistent output.

SUMMARY

Vented check valves, pumps and refill units for dispensers are disclosed herein. Some embodiments disclose a refill unit including a container for holding a liquid. A pump chamber is secured to the container. The pump chamber is defined at least in part by a one-way liquid inlet check valve, a one-way liquid outlet check valve and at least one wall. The volume of the pump chamber is movable between a first volume and a second volume. The inlet check valve includes a venting recess. The venting recess allows air to flow past the inlet check valve in the opposite direction of the flow of liquid into the liquid chamber.

In some embodiments, refill units include a container for holding a liquid and a pump secured to the container. The pump includes a pump chamber and an inlet check valve located upstream of the pump chamber. The inlet check valve includes an annular seal that has a venting recess located in the annular seal. Air in the pump chamber may pass through the venting recess in the annular seal and flow back up into the container that supplies liquid to the pump.

Exemplary embodiments of pumps include a pump chamber defined by a one-way liquid inlet check valve, a one-way liquid outlet check valve and at least one wall. The volume of the pump chamber is movable between a first volume and a second volume. The inlet check valve includes a venting recess. The venting recess allows air to flow past the inlet check valve in the opposite direction of the flow of liquid into the liquid chamber.

BRIEF DESCRIPTION OF THE DRAWINGS

These and other features and advantages of the present invention will become better understood with regard to the following description and accompanying drawings in which:

FIG. **1**A illustrates an cross-section of an exemplary embodiment of a vented check valve;

FIG. **1**B illustrates a plan view of the exemplary embodiment of the vented check valve of FIG. **1**A;

FIG. **2**A illustrates the exemplary embodiment of the vented check valve of FIGS. **1**A and **1**B in a pump connected to a container; wherein the pump is set up to be short-stroked and the piston is at the innermost end of its travel;

FIG. **2**B illustrates the exemplary embodiment of the vented check valve of FIGS. **1**A and **1**B in a pump connected to a container wherein the piston is at the outermost end of its travel;

FIG. **3** illustrates another exemplary embodiment of a vented check valve; and

FIG. **4** illustrates yet another exemplary embodiment of a vented check valve.

DETAILED DESCRIPTION

Exemplary embodiments of check valves, pumps and refill units disclosed herein alleviate problems of air in the liquid pump chamber that prevents a liquid pump from priming when the pump is short-stroked. The exemplary embodiments of vented check valves, liquid pumps, foam pumps and refill units having vented check valves shown and described herein may be used for many applications.

FIG. **1**A illustrates an exemplary embodiment of a vented check valve **100**. One exemplary vented check valve **100** is made of a thermoplastic elastomer (TPE), or a Polyolefin Elastomer, such as Dow Engage® 8401. Vented check valve **100** may be used as an inlet check valve in a liquid pump. Exemplary embodiments of such liquid pumps are described in more detail below. The vented check valve **100** includes a projecting member **102** for securing the valve in position in a pump housing (not shown) and a sealing member **104**. Sealing member **104** includes one or more venting recess(es) or notch(es) **106** in the sealing member **104**. As described in more detail below, venting recess **106** provides a path for air to escape out of a pump chamber (not shown). Venting recess **106** may be a sharp notch, a rounded notch, a hole, one or more slits or the like.

Venting recess **106** has a recess depth **110**. Sealing member **104** has a depth **112**. In one embodiment, the sealing member **104** depth **112** is about 0.090 inches and the venting recess **106** depth **110** is about 0.025 inches. In some embodiments, recess depth **110** of venting recess **106** is less than about 20% of depth **112** of sealing member **104**. In some embodiments, recess depth **110** of venting recess **106** is less than about 30% of depth **112** of sealing member **104**. In some embodiments, recess depth **110** of venting recess **106** is less than about 40% of depth **112** of sealing member **104**. In some embodiments, recess depth **110** of venting recess **106** is less than about 50% of depth **112** of sealing member **104**.

FIGS. **2**A and **2**B illustrate the exemplary vented check valve **100** in a refill unit **200**. Refill unit **200** includes a container **202** for holding a liquid. In some embodiments, the liquid is a foamable liquid. In such embodiments, the exemplary refill unit **200** includes a mixing chamber (not shown)

and an air inlet (not shown) into the mixing chamber. In addition, an air compressor (not shown) would be included. The air compressor may be separate from the refill unit **200** or integral with the refill unit **200**.

Connected to container **202** is a pump housing **203**. Pump housing **203** includes a cap **204** that is securable to container **202**. Cap **204** and container **202** may be connected by a threaded connection, a snap-fit connection, a welded connection, an adhesive connection or the like. A base **205** is located within cap **204**. Base **205** includes a mounting aperture **201** for receiving and retaining vented check valve **100**. During assembly, projection **102** is forced up through aperture **201** and projection **102** retains vented valve **100** in place. In addition, base **205** includes one or more liquid inlet apertures **206**.

Pump housing **203** includes cylindrical wall **208** and cylindrical base **209**. Located within pump housing **203** is a liquid pump chamber **220**. A piston **232** is moveable within liquid pump chamber **220**. In one embodiment, piston **232** is hollow and has a piston head **230** located at one end. An aperture **236** in piston head **230** places the interior of piston **232** in fluid communication with the liquid pump chamber **220**. An outlet check valve **238** is located in fluid communication with the hollow interior of piston **232**, and in one embodiment is located within piston **232**. An outlet **242** is located downstream of the outlet check valve **238**. In some embodiments, a mixing chamber (not shown) and an air inlet (not shown) are included and located downstream of the outlet check valve **238**. In addition, a mix media may be located downstream of the outlet check valve **238**. Mix media may be, for example, one or more screens, baffles, sponge, porous material or the like that causes liquid and air to mix together to form a foam. Piston **232** includes annular projection **246** for engaging with an actuator (not shown) of a dispenser (not shown) for operating pump **203**.

The vented check valve may be used in many types of conventional pumps used today for the dispensing of liquid soap and sanitizers. Other exemplary embodiments of liquid and foam pumps that may be used with the exemplary embodiments of vented check valves include U.S. patent application Ser. No. 13/208,076, titled Split Body Pumps for Foam Dispensers and Refill Units, filed on Aug. 11, 2011; U.S. Provisional Patent Application No. 61/692,290, titled Horizontal Pumps, Refill Units and Foam Dispensers With Integral Air Compressors, filed on Aug. 23, 2012; and U.S. Provisional Patent Application No. 61/695,140, titled Horizontal Pumps, Refill Units and Foam Dispensers, filed on Aug. 30, 2012, each of which is incorporated herein by reference.

Similarly, the vented check valves may be used in many dispensers where it is desirable to short-stroke the dispenser. The dispensers may be designed to be short-stroked, may be modified to be short-stroked in the factory or may be modified to be short-stroked in the field. Exemplary embodiments of dispensers that may utilize the exemplary embodiments of vented check valves if modified to be short-stroked may include, for example, U.S. Pat. No. 7,086,567, titled Wall-Mounted Dispenser Assembly With Transparent Window, filed on Jul. 25, 2002; and U.S. Patent Publication No. 2010/0059550, titled Pump Having a Flexible Mechanism for Engagement With a Dispenser, filed on Sep. 11, 2009, each of which is incorporated herein by reference.

Some prior art pumps fail to prime when the pump is purposely short-stroked to provide a reduce output because air is compressible. Accordingly, if a normal inlet check valve (not shown) is used as a piston travels to its innermost position (which is short of traveling the entire length of the liquid pump chamber) the air compresses. Often the air pressure fails to build up high enough to reach the cracking pressure of the outlet check valve. If it does build enough pressure to open the outlet check valve, some air may escape out of outlet nozzle; however, once the pressure falls below the cracking pressure of outlet check valve, the outlet check valve closes leaving pressurized air in the pump chamber. In addition, with a normal inlet check valve (not shown), as the piston moves outward, the compressed air expands and a vacuum is created in the pump chamber. A normal inlet check valve (not shown) does not open until a vacuum pressure builds up that is greater than the cracking pressure of the normal inlet check valve (not shown). In many cases, although the vacuum pressure increases while the piston moves outward, the vacuum pressure does not increase beyond the cracking pressure of the normal inlet check valve and the valve does not prime.

The refill unit **200** of FIG. **2**A illustrates the piston **232** located at its innermost position when refill unit **200** is installed in a dispenser (not shown) that is set up to short-stroke the pump **203** so that the dispenser has a smaller output dose. In some embodiments, the recess **106** of inlet check valve **100** forms an opening between the inside wall **207** of cylindrical wall **208** and seal **104** of inlet check valve **100**. Thus, vented inlet check valve **100** becomes essentially a normally open valve. Accordingly, liquid may flow into the pump chamber **220** through recess **106** and air may flow out of pump chamber **220** and up into container **202**.

In some embodiments, recess **106** does not form an "opening" between the inside wall **207** and seal **104**; however, it does form a weakened area, or an area that has a lower cracking pressure. In such embodiments, the lower cracking pressure in that area allows air trapped in liquid pump chamber **220** to be forced out of the liquid pump chamber **220** without significantly raising the air pressure in the liquid pump chamber **220**. Accordingly, when piston **232** is moved toward its outermost position, shown in FIG. **2**B, liquid is drawn into liquid chamber **220**.

When piston **232** moves back to the position shown in FIG. **2**A and compresses liquid chamber **220**, air may flow up into container **202** until the air has been evacuated from the liquid pump chamber **220**, sufficient pressure builds to seal of inlet valve **100** against inner wall **207**, or liquid contacts the sealing member **104** and causes the sealing member **104** to seal against inner wall **207**. As the liquid pump chamber **220** continues to compress, liquid is forced from liquid pump chamber **220** through opening **236** and through the hollow interior of piston **232** past outlet check valve **238** and out of outlet nozzle **242**.

FIG. **3** illustrates another exemplary embodiment of a vented inlet check valve **300**. Inlet check valve **300** includes a projection **302** for securing inlet check valve **300** to a housing (not shown). Inlet check valve **300** includes a sealing member **304**. Sealing member **304** has a venting recess **306**. Venting recess **306** has an arcuate shape. Additional shapes for venting recesses are contemplated herein, such as, for example, a sharp notch as shown in FIGS. **1**A-**2**B, a plurality of slits, a u-shape cutout or the like. The venting recess **306** forms a passageway that may be normally open when the inlet check valve is not under pressure from the pump chamber, or forms a weakened cracking pressure in that area for the passage of air that seals to prevent liquid from flowing past.

FIG. **4** illustrates yet another exemplary embodiment of inlet check valve **400**. Inlet check valve **400** is illustrated in a pump housing **450**. Check valve **400** has an interference fit with housing **450** (which is exaggerated in FIG. **4** and not shown to scale for illustrative purposes). Sealing member **404** has a contact depth **430** with wall **450**. Vented recess **406** has a recess depth **420**. In one embodiment, sealing member **404**

has a contact depth **430** of about 0.011 inches and venting recess **406** depth **420** of about 0.025 inches. In some embodiments, recess depth **420** is greater than about 100% of contact depth **430**. In some embodiments, recess depth **420** is greater than about 130% of contact depth **430**. In some embodiments, recess depth **420** is greater than about 140% of contact depth **430**. In some embodiments, recess depth **420** is greater than about 150% of contact depth **430**. In some embodiments, recess depth **420** is greater than about 200% of contact depth **430**.

While the present invention has been illustrated by the description of embodiments thereof and while the embodiments have been described in considerable detail, it is not the intention of the applicant to restrict or in any way limit the scope of the appended claims to such detail. Additional advantages and modifications will readily appear to those skilled in the art. Moreover, elements described with one embodiment may be readily adapted for use with other embodiments. Therefore, the invention, in its broader aspects, is not limited to the specific details, the representative apparatus and illustrative examples shown and described. Accordingly, departures may be made from such details without departing from the spirit or scope of the applicant's general inventive concept.

I claim:

1. A refill unit for a dispenser comprising:
a container for holding a liquid;
a pump secured to the container;
the pump having a pump chamber;
an inlet check valve located upstream of the pump chamber;
the inlet check valve having an annular seal; and
a venting recess located in the annular seal;
wherein air in the pump chamber may pass through the venting recess in the annular seal and flow into the container;
wherein the venting recess depth is less than about 30% of the contact depth of the annular seal against a wall of the pump chamber.

2. A refill unit for a dispenser comprising:
a container for holding a liquid;
a pump secured to the container:
the pump having a pump chamber;
an inlet check valve located upstream of the pump chamber;
the inlet check valve having an annular seal; and
a venting recess located in the annular seal;
wherein air in the pump chamber may pass through the venting recess in the annular seal and flow into the container;
wherein the venting recess depth is less than about 50% of the contact depth of the annular seal against a wall of the pump chamber.

3. A pump comprising:
a pump chamber;
the pump chamber defined by a one-way liquid inlet check valve, a one-way liquid outlet check valve and at least one wall;
the volume of the pump chamber movable between a first volume and a second volume;
the inlet check valve having an annular seal and a venting recess;
wherein the venting recess allows air to flow past the inlet check valve in the opposite direction of the flow of liquid into the pump chamber;
wherein the venting recess depth is less than about 50% of the contact depth of the annular seal against a wall of the pump chamber.

4. A pump comprising:
a pump chamber;
the pump chamber defined by a one-way liquid inlet check valve, a one-way liquid outlet check valve and at least one wall;
the volume of the pump chamber movable between a first volume and a second volume;
the inlet check valve having an annular seal and a venting recess;
wherein the venting recess allows air to flow past the inlet check valve in the opposite direction of the flow of liquid into the pump chamber;
wherein the venting recess depth is less than about 50% of the contact depth of the annular seal against a wall of the pump chamber.

5. A refill unit comprising:
a container for holding a liquid;
a pump chamber secured to the container;
the pump chamber defined at least in part by a one-way liquid inlet check valve, a one-way liquid outlet check valve and at least one wall;
the volume of the pump chamber movable between a first volume and a second volume;
the inlet check valve having a venting recess;
wherein the venting recess is located in a portion of the inlet check valve that contacts a wall to form a one-way seal;
wherein the venting recess allows air to flow past the inlet check valve in the opposite direction of the flow of liquid into the pump chamber.

6. A refill unit for a dispenser comprising:
a container for holding a liquid;
a pump secured to the container;
the pump having a pump chamber;
an inlet check valve located upstream of the pump chamber;
the inlet check valve having an annular seal; and
a venting recess located in the portion of the annular seal that seals against a wall;
wherein air in the pump chamber may pass through the venting recess in the annular seal and flow into the container.

7. The refill unit of claim **1** wherein the venting recess is a notch.

8. The refill unit of claim **1** wherein the venting recess has an arcuate shape.

9. The refill unit of claim **1** wherein the venting recess depth is greater than about 100% of the contact depth of the annular seal against a wall of the pump chamber.

10. The refill unit of claim **1** further comprising a mixing chamber and an air inlet.

11. The refill unit of claim **10** further comprising an air compressor secured to the refill unit and in fluid communication with the air inlet.

12. The refill unit of claim **1** further comprising a liquid.

13. The refill unit of claim **12** wherein the liquid is a foamable liquid.

14. The refill unit of claim **1** further comprising a piston movable within the pump chamber.

15. A pump comprising:
a pump chamber;
the pump chamber defined by a one-way liquid inlet check valve, a one-way liquid outlet check valve and at least one wall;

the volume of the pump chamber movable between a first volume and a second volume;

the inlet check valve having a venting recess;

wherein the venting recess is located in a portion of the inlet check valve that contacts a wall to form a one-way seal;

wherein the venting recess allows air to flow past the inlet check valve in the opposite direction of the flow of liquid into the pump chamber.

16. The pump of claim **15** wherein the venting recess is a notch.

17. The pump of claim **15** wherein the venting recess has an arcuate shape.

18. The pump of claim **15** further comprising a mixing chamber and an air inlet.

19. The pump of claim **15** further comprising a container secured to the pump and a liquid in the container.

20. The pump of claim **15** further comprising a piston movable within the pump chamber.

* * * * *